ENERGY AUDIT STUDY

at

THE NATIONAL PRODUCTS
BANGALORE

UNDER
INDIA-EC ENERGY BUS PROGRAMME

Sponsored by

ENERGY MANAGEMENT CENTRE
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THE NATIONAL PRODUCTS

BANGALORE

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E N E R G Y A U D I T R E P O R T

1.0 INTRODUCTION

A comprehensive energy audit study was carried out by a team from TERI, to identify energy saving opportunities in the plant.

The National Products is one of the well known confectionary company and produces popular sweets such as Minti, bubble gums, etc.,

The plant uses steam for its process such as mixing, melting, evaporation, drying, etc., It uses electrical energy for running motors, air conditioning and dehumidification. The company uses about 50,000 units of electricity and 25 KL of furnace oil, per month. The total energy bill of the company is of the order of about Rs.25 lakhs a year.

During the study, a detailed analysis was made of the major energy consuming plant items/processes, supplemented by measurements of various energy related parameters using appropriate instruments, in order to determine their energy efficiencies and evolve suitable means to minimise wastages.

This report presents the findings, recommendations, and the financial implications of implementing these recommendations.

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2.0 EXECUTIVE SUMMARY

The plant uses about 50,000 units of electricity and 25 KL of furnace oil per month. The total energy bill of the company is of the order of about Rs 25 lakhs a year. This plant uses furnace oil to generate steam which is used for its process such as mixing, melting & drying etc., and electricity for running motors and airconditioners.

This report consists of five main sections. In Section 3, a brief description of overall process is outlined and in Section 5 to 7 the details of energy saving opportunities with analysis and recommendations for steam generation and utilisation, airconditioning and electrical system are presented.

A brief summary of above sections is given below.

1.0 STEAM GENERATION

A careful diagnosis and analysis of the boiler operation and maintenance has revealed energy saving opportunities in the following areas :

1. Presently flame setting is done manually by checking flame size and colour which will lead to ineffective boiler operation. Adjusting the flame for 3 to 3.5% oxygen in the flue gases will result in an energy saving of 1200 lit. of oil or Rs.5500 per annum.

2. Major amount of steam generated is mainly used for indirect heating facilitating easy recovery of 50 - 60% of steam utilised. By collecting steam condensate and sending back to boiler will save 5% of fuel per annum which comes to 15,000 lits. of furnace oil or Rs. 69,000 per annum.

3. It was observed that steam was leaking through the safety valve, water level indicator and also through main steam valve. By arresting these leakages, energy worth of 1000 lit. of furnace oil or Rs. 45000 could be saved.

4. The recovery of steam condensate will reduce the requirement of treated boiler feed water by 50% which will result in a saving of Rs. 20,000 per annum.

2.0 STEAM UTILISATION

Detailed study of steam distribution and utilisation aspects have revealed the following energy saving opportunities.

1. Uninsulated steam pipes, valves, flanges, and other pipe joints were noticed throughout the plant. It is recommended to insulate these items. By implementing the above recommendations, it is possible to save energy worth of 5700 lit. of oil Rs.27000 per annum.

2. It was also noticed that live steam was leaking through pipe joints and valve handles in minti and gum base preparation room. By arresting these leakage it is possible to save 2600 lits. of furnace oil or Rs.11,700 per annum.

3. Some of the steam traps and strainers were oozing out live steam continuously. By replacing this faulty traps and strainer will result in a saving of 3000 lit. of furnace oil per annum worth of Rs.12,500.00

4. There is no proper temperature control in the process kettles and mixers. By employing suitable on-off temperature controllers and using low pressure steam for low temperature application will result in a saving of about 5% of the steam utilised by the respective process vessels.

3.0 AIR CONDITIONING

Air conditioners are the major electrical energy consuming equipments. A thorough study on its operation and maintenance has been given the following short comings :-

1. Poor house keeping measures
2. No proper temperature control in the rooms
3. Poor insulation of ducts, windows and doors
4. Uneven distribution of cold air
5. No preventive maintenance
6. No data logging for air conditioners

Taking corrective steps to overcome these will lead to a saving of minimum 15% of the compressor power input, which works out to be approximately 22,500 units or Rs.31,500 per annum. A detailed discussions for individual process rooms are given in Section 6.0.

4.0 ELECTRICAL SYSTEM

1. It was observed that most of the motors are over designed and are operated below its optimum load. It is recommended to replace these motor with a low HP, high efficiency motor in a phased manner.
2. Capacitor panels are fixed in the main distribution room. It is recommended to connect these capacitors near or at the load centre points.
3. It was observed that lagging power factor changed to leading power factor during lunch time. This could be avoided by switching off the capacitors during lunch time or locating the capacitors to the respective load centres.

5.0 SUMMARY OF POTENTIAL SAVINGS

Sl. No.	Details	Lit of Oil	Units	Amount Rs.
1.	By proper flame setting	1200	-	5500.00
2.	By condensate recovery	15000	-	69000.00
3.	By Arresting steam leakage	3600		16560.00
4.	By insulating pipes, flanges, valves, etc.,	5707	-	27000.00
5.	By proper maintenance and insulation of A/c plant and its ducts rooms	-	22500	31500.00
6.	By replacing faulty steam traps & valves	3000	-	12500.00
7.	By reducing the amount of treated boiler feed water as the result of condensate recovery	-	-	20000.00

Total oil saved per annum = 1,50,500.00

Total electricity saved per annum = 31,500.00

Total cost savings per annum = 1,82,000.00

6.0 ACKNOWLEDGEMENT

We are thankful to the management and staff of The National Products for the kind cooperation given to us for carrying out the energy audit and in providing all the relevent information.

We are thankful particularly to Mr V Prabhakar Rao Production Manager for extending his fullest cooperation in completing this study.

.0 PROCESS DESCRIPTION

The manufacturing process is broadly made up of seven sections as under - the description of each section is briefly outlined :

1. Gum base making
2. Gum mixing room
3. Coating room
4. Pulvarising room
5. Bubble gum extruder
6. Wraping room
7. Packaging room

GUM BASE MAKING

Latex, gums and emulsifiers are mixed and charged to a mixing cum heating equipment. The entire charge is heated indirectly through the jacket by saturated steam at 90 psi pressure and maintained between the temperature 100- 110 ^{o} C. Since the end product is highly viscose in nature, helical mixers are used and are powered by 20 HP motors. There are 3 number of such units. This is working only 8 hrs/day.

GUM MIXING SECTION (ROLLING & SCOURING)

Gum base is mixed with pure sugar and other ingredients. It is melted in a agitated jacketed kettle using steam at 90 psi and the temperature is maintained at 110 ^{o} C. The viscous final product is withdrawn from the kettle and dried to a semi solid dough. Fully kneaded dough is rolled and scoured in a machine. Cold air at 23 ^{o} C is blown over the rolled dough to bring down its temperature .After rolling, dough is cut into small pieces of required size and taken for coating.

COATING ROOM

Sugar syrup along with flavours, is coated on the bubble gum sweet pieces in a rotating conical mixer cum dryer. Chilled air is blown over bubble gum pieces to facilitate drying. Sugar syrup is prepared in a separate tank and pumped to coating room. Total no. of dryers are 24 and are power by 3 HP motor individually.

CURING ROOM

Sugar coated final products are placed on trays and kept in a controlled environment for 7 days. Temperature is maintained between 20 and 22 ^{o} C and humidity is maintained at 50-55%. Curing is necessary to avoid cracks in the product and reduce its britileness. Since it is hygroscopic in nature (tendency to absorb moisture and become sticky) humidity is maintained at 50-55r H.

MINTI PREPARATION

Sugar syrup mixed with flavours, a few resins and other ingredients is fed into a batch jacketed evaporative kettle. Vacuum is maintained inside the kettle to lower boiling temperature. Steam is used as heating medium. Final product is a semi solid viscous product which is cooled outside and kneaded manually for further processing. At luke warm temperature entire mass is fed into the miniti extruder. The punched out sweet are fed to a conveyor where it spreads uniformally over a 3 tier conveyor dryer. Cold air is used for drying. Humidity is maintained at 50% rH. After drying, it is weighed and packed according to market demand.

EXTRUSION & WRAPING ROOM

Other special types of sweets are prepared by extrusion from a well kneaded processed dough. Two nos. of extroders and 3 nos. of wraping machines are located in air conditioned room. Temperature is maintained at 27.3 ^{o} C and rH at 55%. A/c plant is installed inside the room.

PACKAGING UNIT

Final product is weighed and packed in this unit. Temperature is maintained at 27^{0} C and rH at 55%. Major energy consuming areas are A/c and lighting.

4.0 ENERGY MANAGEMENT

The company managment is generally aware of the importance of energy conservation, its impact on their product cost and net profit. However, energy consumption pattern and specific energy are not regularly analysed.

RECOMMENDATIONS

1. No attempt has been made to measure the steam and electricity consumed by individual sections. It is recommended to fix meteres in all sections , in order to regularly analyse the energy consumption trends , as well as specific energy for individual product.

2. Every shift individual supervisor should provide energy consumed by his section to the Plant Manager, who in turn will consolidate the figures in the form for every month and present this to General Manager. After careful analysis of the data, the General Manager will take whatever steps are necessary, to control exessive consumption. The General Manager will also set targets for bringing down energy consumption.

   Since it is a small plant, Plant Manager can take this additional charge as Energy Manager.

3. Energy co-ordination meeting should be held at three months interval to analyse targets and monitoring procedures.

5.0 STEAM GENERATION AND UTILISATION

5.1 STEAM GENERATION

A. PLANT DESCRIPTION

This plant utilises steam as heating medium for melting, evaporation, drying etc., and also for its various other unit operations. Steam is generated in the boiler and distributed to different sections of the plant. Total steam demand by the overall plant is 1.5T/hr and is being met by one boiler by operating/firing itermittently. Furnace oil is fuel for the boiler.

There are two nos. 5 T/hr, Westerworth Boilers and one No. 400Kg/hr Thermax Boiler . All are smoke tube packaged boilers fitted with burners, primary and secondary air blowers, furnace oil heat exchangers with heating coil along with on/off thermostatic control. Furnace oil is stored in an underground storage tank and pumped to day tank.

Burner ignition and flame setting is done manually by looking at the flame colour and size. It has a water treatment unit for boiler feed water. No preheating of oil is done in the underground and day tank.

B. OPERATION

Furnace oil from day tank is pumped through heat exchanger to raise its temperature to 150^{o} Furnace oil is heated by a 10 KW heater, provided with on/off thermostate control. Preheated oil is fed to the burner where it is automised and mixed with primary and secondary air for complete combustion. Oil flow rate is adjusted by maintaining the oil pressure.

Oil fuel ratio is adjusted manually by opening or closing the air dampers. Treated feed water is fed into Boiler through a centrifugal pump and water level is maintained by the level controller. Steam pressure is maintained in the boiler between 80 - 100 psi by firing the boiler intermittently. Safety valve settings are at 125 psi.

C. EXPECTED ENERGY SAVINGS

A careful diagnosis and analysis of the boiler operation and maintenance has revealed energy saving opportunities in the following areas : -

1. Flame setting is done manually by checking flame size and colour which leads to ineffective boiler operation ;

2. No condensate is recovered and returned to Boiler ;

3. Steam leakage through the safety valve water level indicator and joints ;

By operating the boiler more efficiently and arresting steam leakage in the Boiler house , energy worth of Rs. 1,00,000 / Annum could be achieved. Please refer Annexure I & III. Details are discussed below.

D. OBSERVATIONS & GENERAL RECOMMENDATIONS

1. Flame setting has to be done by checking the CO_2/O_2 content and temperature of flue gas. The optimum CO_2 levels are 13-14%. For every $17^{o}C$ rise in flue gas temperature there will be 1% reduction in boiler efficiency.

2. Boiler is being operated at full load by intermittent and not continuously at low load. This is desirable as excess air will be reduced, reducing flue gas energy losses. This also helps in minimising the radiation losses.

3. It was observed that there is frequent clinker formation at the burner nozzle. The size is about 20 cm dia sphere. It forms three times a day. This is probably due to the damage in the nozzle angle or quarl. Apart from the energy waste, it is a potential safety hazard. It is recommended to overhaul the burner immediately.

4. There is no glass cover for the ignition cum reviewing port. Secondary air is coming out through the port resulting an incomplete combustion and soot formation. It is recommended to shut the port with glass cover after each ignition.

5. Steam was leaking through the safety valve, water level indicator and mainline steam valve. As these losses comes to 1000 lit. of furnace oil per annum, it is recommended to arrest immediately.

6. During burner cleaning care must be taken to ensure that the pokers used for burner nozzle cleaning is smaller in dia than the diameter of nozzles. Operators are using crude iron rods for cleaning the burner nozzle, which has a negetive effect on the burner life.

7. Presently the fuel oil level and feed water level in the day tank is measured once in a day. It is recommended to take the dip reading once in a shift, so that it is possible to check the quantum of steam produced, oil consumed and also its thermal efficiency .

8. Plant uses about 1.5 T steam/hr and most of them for indirect heating. It is possible to recover 50-60% of the steam condensate and at 80 ^{o} C and feed it back to the boiler thereby saving energy worth of 15,000 lit. of furnace oil or otherwise Rs.69,000 per annum . (refer Annexure II for details).

9. There is no canopy for one of the chimneys, It is recommended to fix it immediately to avoid corrosion inside the chimney and acid smut emission, and to decrease the carbon deposit inside the wall due to quenching of flue gas by rain water.

10. No attempt is made to pre-heat the boiler feed water or the combustion air, by the hot condensate water. It is recommended to consider heat recovery system for this.

11. Amount of soot / stack brick particles generated during each boiler firing was measured using smoke pump and filter paper.

    It was seen that each firing causes different amounts of smoke particles, indicating variations in excess air or air fuel ratio. It is recommended to check the smoke soots periodically, to control the scale formation in chimney and also to alliviate air pollution problems.

12. Boiler blow down time is 1 1/2 minutes. Since it is operated intermittently. Solid accumulation levels are lesser than what would be when in continuous operation. It is recommended to reduce the boiler blow down time to 60 seconds.

13. By condensate recovery, it is possible to save 5000 lit./day of treated boiler feed water, resulting in a saving of Rs.20,000/= feed water.

5.2 STEAM DISTRIBUTION AND UTILISATION

A. Energy savings are possible in different sections of this plant by :-

1. Insulating unlagged pipes, valves, flanges, and other pipe joints
2. Arresting visible steam leakage through pipe joints
3. Proper sizing of steam distribution lines
4. Proper temp. control on process heating
5. Employing good quality steam traps

The details are discussed below.

B. OBSERVATIONS AND RECOMMENDATIONS

GUM BASE PREPARATION

1. In gum base preparation unit, steam at 90 psi is used as a heating medium to heat up and maintain the charge mixture at 100 - 110 ^{o} C. And no effort has been made to recover the condensate and the existing steam traps are oozing out live steam. The steam distribution lines are not in good condition and small patches of bare lines are exposed to ambient air. By changing the steam traps and insulating bare steam lines, considerable amount of energy is possible. It is recommended to implement this immediately.

One more point, also worth considering is that for maintaining 110 ^{o} C, steam at 170 ^{o} C is used. If the existing heat transfer area and the increased batch time is not going to affect the productivity considerably, possibility of using steam at lower pressure with pressure reducing valves may be considered. Energy losses from low pressure steam and condensate is less than heating with pressure steam.

2. MIXING KETTLE

Steam is being used at 90 psi to heat and melt the gum at 100 - 110 ^{o} C. Patches of uninsulated main steam lines were seen with steam leakage through different pipe joints. No attempt has been made to recover steam condensate and flash steam. Substantial quantity of saving can be achieved by insulating the bare pipes, valves, changing the steam traps and recovering steam condensates. Other recommendations made regarding using low pressure steam may be applicable for this equipment also.

3. SUGAR SYRUP PREPARATION TANK

This is a open rectangular stainless steel tank heated by live open steam. The pressure used here is 90 psi which is really more than required for just heating the contents to 65 ^{o} C. The amount of flash steam produced from the tank due to high pressure steam and limited heat transfer area, is substantial.Use of low pressure steam is advisable for this process as it will reduce the steam consumption. The possibility of using helical heating coil has to be looked into in order to recover the steam condensate back to boiler. The general layout and the

manner in which the steam lines drawn are not satisfactory. Energy is wasted in the uninsulated main steam lines, steam traps and through faulty pressure guages and pipe joints. Immediate measures have to be taken to arrest the leakage and insulate the steam fittings.

4. MINTI PREPARATION

Steam is utilised in the vacuum evaporator kettle as heat source. This is one of the major steam consuming units. To feed this, one separate thermax baby boiler with a capacity of 400 Kg/hr was commissioned but due to steam pressure fluctuations at peak loads, it is not operated and steam is drawn from the main boiler.

Steam line insulation is in badly damaged condition and steam traps used are liberally letting out live steam at 90 psi. No measure is taken to recycle the hot condensate back to the boiler but it is drained in to the open gutter from where a/c plant takes its fresh air resulting hot humid air intake. The flash steam generated in the room is increasing the humidity of the room and also infiltered into the adjacent room where humidity levels have to be maintained at 50% rH. As the humidity levels are high, separate Dehumidifier is installed at the drying room.

There is a proposal to replace the 400 Kg/ hr thermax boiler with a higher capacity one. The existing boiler capacities is 5T/hr, whereas the steam utilisation is 1.5T/hr. Already it is under low load condition. Hence it is recommended to raise sufficient steam from existing facility. To avoid pressure drop, a new steam line may be laid from the boiler house.

TABLE : 1

EXPECTED ENERGY SAVINGS IN STEAM DISTRIBUTION & UTILISATION

Sl. No.	Details	Energy savings per Annum in terms of	
		Fuel (lit)	Rs.
1.	Lagging uninsulated pipes	2097	9640.00
2.	Lagging uninsulated flanges	935	4300.00
3.	Lagging uninsulated valves/fittings	2600	12000.00
4.	Replacing faulty steam traps and strainers	3000	12500.00
5.	Arresting steam leakage in the pipe joints & holes	2600	11700.00

By implementing above discussed recommendations, it is possible to save energy worth of 11,200 lit. of furnace oil per annum or Rs. 50,000/= per annum. Total energy savings in steam distribution and utilisation is given in Table - 1. Details of energy savings are given in Annexure - III, IV and V.

6.0 AIR CONDITIONING

6.1 PLANT DESCRIPTION

There are two central airconditioners of capacity 40 Tons and 90 Tons/hr and a few window air conditioners of 1.5 Ton capacity each.

One of the Central Air conditioners is located near the confectionery unit and the other near curing room.

Temperature in the process areas namely curing, wrapping and packaging rooms have to be maintained at 20 - 22 ^{0}C with a relative humidity of 50-55%. Extruders and packaging machines are kept inside the A/c room.

6.2 ENERGY SAVING POSSIBILITIES

Electricity is major energy source and a small amount of steam is used for heating and maintaining relative humidity. Chilled air is utilised for drying, cooling and other processes. Airconditioning is operated 16 hours a day. After careful analysis of the functioning of air conditioners and its maintenance, the following shortcomings were noted.

1. Poor house keeping measures
2. No proper temperature control
3. Poor insulation of ducts, doors and windows
4. Uneven distribution of air
5. No proper maintainance

Corrective steps to overcome these, will lead to a saving of minimum 15% of the compressor power input, which works out to approximately Rs.31,500/= annum. For details refer Annexure VI.

6.2 OBSERVATIONS AND RECOMMENDATIONS

A. CURING ROOM

Sugar coated final products are placed on trays and kept at 20 -22 ^{o}C with a relative humidity of 50-55% for 7 days. Curing is necessary to avoid cracks and reduce britleness of products. The observations are :

1. Ordinary door without any door closer is used. As the door is not closing properly hot air is infiltered into the cold room through door gaps. It is recommended to replace the existing door with an air tight insulated door fixed with a door closer. By this load on air conditioner can be reduced considerably thus saving energy.

2. Poorly insulated main steam lines are passing through this room, resulting more heat load on compressor. It is recommended to provide good insulation to this steam line.

3. There is lot of head space in the room which is unnecessarily being cooled. This space may be reduced by providing false ceiling which reduces heat gain by cold air as well as load on compressor.

4. The weight of trays and supports used in curing room is slightly on the higher side. Cooling load from trays are more or less equal to the products. Hence it is recommended to consider using light weight trays and stands to save energy.

B. COATING ROOM

In this room, cold air is used for drying sugar syrup coated bubble gums in a rotating conical mixer. The following energy saving observations are made.

1. The contact between cold air and bubble gum pieces are less thus leading to excess cold air requirement. Efforts should be made to increase the surface area or recycle a part of cold air back into the mixer which will result in energy saving.

2. Cold air escapes from this room as the room is not closed. Closing the door and recycling back the cold air into the suction duct will lead to considerable energy savings.

3. If possible the cold air from curing room may be used for cooling the warm dough in the adjacent room.

4. The possibility of using ambient cold air in the early morning and late evening for drying the dough may be explored on trial basis, which will definitely cut down the energy bill considerably.

C. MINTI PREPARATION ROOM

Punched out hot minti pieces are dryed in a three tier conveyor dryer. Cold air is used for drying. The temperature and relative humidity are very critical to maintain product quality. The following observations are made :

1. There is no proper door for this room resulting hot humid air infiltration from the adjacent processing room. It is recommended to provide an air tight insulated door with a door closer.

2. Fresh air intake for the dehumidifier is directly faceing the steam and condensate drains, resulting hot humid air intake. It is recommended to shift the intake line to a colder place.

3. The contact between cold air and minti pieces is poor, which increases the cold air requirement for drying. Effort should be made to increase the same to save energy.

D. EXTRUSION AND WRAPING

Two extruders and three wraping machines are placed inside the air conditioned room. Temperature has to be maintained at 22 °C with a relative humidity of 50 -55%. Air conditioner is located inside the room.

1. Room temperature is maintained at 27.3°C instead of 22°C. It is recommended to maintain the required temperature.

2. Doors and windows, are poorly insulated and there is no proper door closer in all doors. Lot of cold air is escaping through the door gaps. A big lift door opening of 2m x 1.5 m is not closed resulting heavy loss of cold air into atmosphere. It is recommended to close this opening immediately. By implementing this it is possible to save 5% of energy.

3. Insulation of all ductlines are worn out. Heat gain is more through this. It is better to insulate the ducts to save energy.

7.0 ELECTRICAL SYSTEM

Electricity is used for running motors, air conditioners and other general purposes including lighting. Average electricity consumption is 50,000 KWH per month. Average power factor is maintained at 0.9 using capacitors.

1. It was observed that most of the motors are overdesigned and are operated below its optimum load. It is recommended to replace these motors with a high efficient motors.

2. Capacitor panels are fixed in the main distribution room. It is recommended to connect these capacitors near or at the load centre points.

3. Lagging power factor became a leading power factor during lunch time. This could be avoided by switching off the capacitors during lunch time or distributing the capacitors to the respective load centres.

8.0 SUMMARY OF POTENTIAL SAVINGS

Sl. No.	Details	Lit of Oil	Units	Amount Rs.
1.	By proper flame setting	1200	-	5500.00
2.	By condensate recovery	15000	-	69000.00
3.	By Arresting steam leakage	3600		16560.00
4.	By insulating pipes, flanges, valves, etc.,	5707	-	27000.00
5.	By proper maintenance and insulation of A/c plant and its ducts rooms	-	22500	31500.00
6.	By replacing faulty steam traps & valves	3000	-	12500.00
7.	By reducing the amount of treated boiler feed water as the result of condensate recovery	-	-	20000.00

Total oil saved per annum = 1,50,500.00

Total electricity saved per annum = 31,500.00

Total cost savings per annum = 1,82,000.00

ANNEXURE: I

ENERGY SAVINGS IN FLAME SETTING

Sl. No.	Flue gas 02	Exit gas Temp.	% Flue gas Loss
1.	3.2	228	15%
2.	4.0	235	15.4%

By reducing flue gas oxygen content from 4.0 to 3.2, 0.4% flue gas heat loss can be saved.

Oil consumed per day = 1000 litres

Total heat released per day = 1000 x 9900
9900000 K.Cal

Therefore Amount of heat saved = 9900000 x 0.004

= 396000 K.Cal

= 4 lit/day

Fuel oil saved per annum = 4 x 300

= 1200 litres

In terms of Rs. = 1200 x 4.6 = 5500.00

ANNEXURE : II

ENERGY SAVINGS IN CONDENSATE RECOVERY

Amount of steam produced per day = 12 Tons

As most of steam is used for indirect steam heating, atleast 50% can be returned as condensate at 70 & 80 ^{o}C.

Amount of fuel saved by 50% condensate recovery =

= 5% of the boiler fuel

Fuel oil saved per day = 1000 x 0.05

≐ 50 litres

Fuel oil saved per annum = 50 x 300

= 15,000 litres

In terms of Rs. = 15,000 x 4.6

= 69,000.00

ANNEXURE : III

ENERGY SAVINGS IN ARRESTING STEAM LEAKAGE

Sl. No.	Steam Pressure	Hole size	Location
1.	7 Kg / cm2	0.8 mm , 2 nos	Minti room
2.	7 "	0.5 mm , 2 nos	Boiler House
3.	7 "	0.6 mm , 2 nos	Gum base room

Steam interms of fuel oil wasted per annum through 8 mm hole

1, 0.8 mm hole = 1500 lit

2, 0.5 mm hole = 1000 lit

3, 0.6 mm hole = 1100 lit

Therefore oil saved per annum = 3600 litres

In terms of Rs. 16,560.00

ANNEXURE : IV

ENERGY SAVINGS IN UNINSULATED FITTINGS

Sl. No.	Details	Size mm	Equivalent length	Litre of oil lost/annum metre	Total oil lost per annum
1.	Uninsulated pipes	25	3 m	59	177
		80	2 m	140	280
		40	10 m	81	810
		50	6 m	100	600
		20	5 m	46	230
2.	Uninsulated flanges	25	1.6 m	59	94.4
		80	3.0 m	140	420.0
		40	1.6 m	81	128.0
		50	2.4 m	99	238.00
		20	1.2 m	46	55.00
3.	Uninsulated valves	25	10 m	59	590
		80	3 m	140	420
		40	5 m	81	405
		50	8 m	100	800
		20	10 m	46	460
			TOTAL OIL SAVED		5707 Litres

Energy saved in terms of Rs. 5707 x 4.6 = 27,000/=

A N N E X U R E - V

ENERGY SAVINGS IN REPLACING FAULTY STEAM TRAPS

No. of steam traps leaking = 5

Size of each trap = 1" & 1 1/2"

Amount of steam leakage through each trap = 20 Kgs/day

(Issuing live steam continuously)

Therefore steam wasted per day = 100 Kgs

Therefore Energy saved per annum = 3000 lit.

In terms of Rs. = 12,500.00

ANNEXURE : VI

ENERGY SAVINGS IN AIR CONDITIONING

1. Power required for 40 T A/c = 25 HP
2. Power required for 90 T/A/c = 50 HP

Therefore Total Power = 75 HP

% Loading 75% = 56 HP

Total power consumed per day = 500 units

Per Annum = 150000 units

15% energy savings = 150000 x 0.15

= 22,500 units

In terms of Rs. 31,500/=